Application of Resistmetry to the Corrosion Study of Metals

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Resistmetry is a traditional technique used for corrosion monitoring of steels embedded in concrete or used in corrosive environments. For uniform corrosion resist-metry provides information such as corrosion loss of metals from a simple concept, i.e., specimen shrinks due to corrosion and thus resistance R increases. In this study, wire electrodes with small cross section (0.1 mmϕ) were used for resistance measurement, and high sensitivity was achieved for analysis of anodic dissolution depth, oxide growth and electronic property of oxide films on Fe, Ti and Al.

Figure 1 shows resistance change of Fe wire electrode during potential sweep. Clearly R increases in the active potential region due to anodic dissolution. Dissolution depth d at each cycle was calculated to be ca. 80 nm and showed good agreement with that from anodic charge.

Figure 2 shows relationship of thickness d, decrease in thickness of metallic Fe of wire electrode), and electrode potential, converted from data of Fig. 1 for 3rd sweep. Increase in d during potential rise is contributed by the passive film growth. The resolution of d was achieved in the order of nm after noise reduction of original data. Change in d is rather larger than the value predicted from growth of the passive film which is ca. 1.5 nm at 0.6 V and 3.5 nm at 1.5 V, probably due to contribution of anodic dissolution of iron during anodic polarization. Decrease in d during potential lowering seems to be concerned with thinning of the space charge layer in the n-type semiconductor passive film. For Fe wire electrode application of resistmetry to pitting dissolution was also examined.

Figure 3 shows an another type of dissolution of Al wire electrode. Resistance R increased considerably during cathodic polarization. This is probably caused by dissolution of Al surface due to local alkarization accompanying with hydrogen evolution reaction. Thickness of Al dissolution was calculated to be 220 μm, 90 μm, and 40 μm for each sweep.

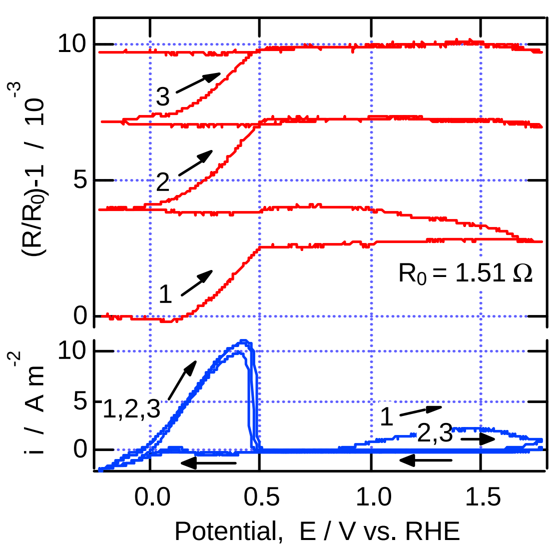

Fig. 1 Polarization curve and resistance change of iron wire electrode during potential sweep with 10 mV s^{-1} in pH 6.5 borate solution.

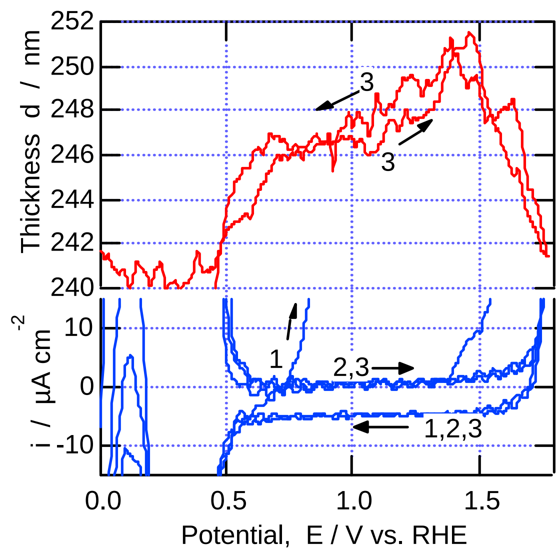

Fig. 2 Expansion of polarization curve and change in thickness, d, for the 3rd potential sweep converted from Fig. 1.

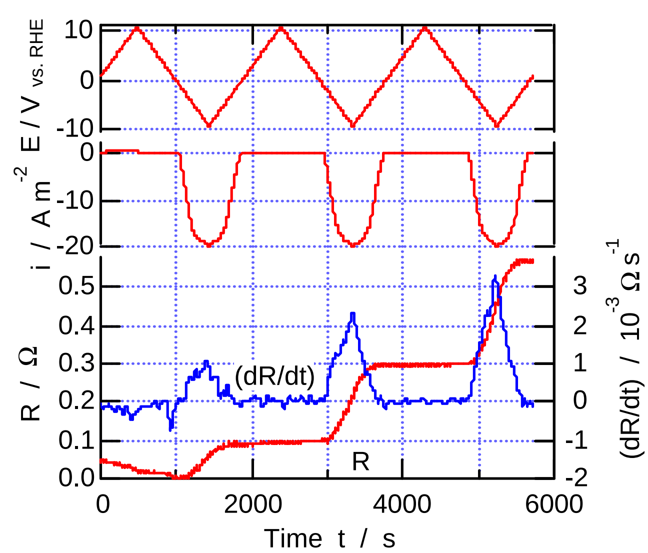

Fig. 3 Time variation of resistance of Al wire electrode during potential sweep with 20 mV s^{-1} in pH 8.4 borate solution.

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